Task Allocation and Base Placement for Mobile Robots in Changeable Assembly

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Abstract

This paper addresses the challenge of achieving automated changeable assembly processes responding to the demand for individualised products and the shortage of skilled workers. To enable changeable assembly with mobilised resources and robots, novel planning and control mechanisms are required. This paper presents a framework to close the gap between high-level factory planning and low-level robot control by considering coercive spatial conditions for allocating tasks to mobile robots. The proposed task allocation framework considers the robots' reachability, clusters the task poses to allocate them to robots, and calculates the robot's base placement. Firstly a search space for possible base placements around the product on which the tasks are to be performed, limited by a maximum and minimum distance to ensure reachability is created. Secondly, the assembly tasks are clustered, and for each cluster, a second search space limited by the maximum reachability from the cluster's centre is created. Thirdly both search spaces are overlapped. Finally, the overlapped space is discretised, and these discrete base placements are evaluated based on the reachability of tasks. The proposed framework is initially tested and simulated in the Robot Operating System (ROS). Subsequently, it is validated on an industrial use case in our laboratory